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*Deaths in each Month, of the foregoing period.*

	Adults.	Child.		Adults.	Child.
January, . . .	91	45	July, . . .	111	263
February, . . .	73	50	August, . . .	109	188
March, . . .	91	63	September, . . .	88	97
April, . . .	96	73	October, . . .	71	83
May, . . .	81	98	November, . . .	81	71
June, . . .	95	132	December, . . .	59	62
	<hr/> 527	<hr/> 461		<hr/> 519	<hr/> 764
					TOTAL...2271

The foregoing Statements were drawn up with as much accuracy as possible, from the Returns given to the Board, from Physicians and others. Any suggestions, for future improvements, will be thankfully received.

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By reference to the Census taken by order of Congress, we find the population of the City and Liberties of Philadelphia, and that part of the county connected with the preceding Bills of Mortality, to have been as follows:

Census.	City.	Suburbs.	County.	Total.
1790	28522	13998	3657	46177
1800	41299	26641	4201	72141

A new Census will be taken in 1810.—The present population may be safely estimated at 100000, or upwards.

The population of the State of Pennsylvania, by the same Census, appears to have kept pace with that of the City &c.

1790...434373      1800...602373

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## No. LXI.

*An Account of Experiments made on Palladium, found in combination with pure Gold. By Joseph Cloud, an Officer in the Mint of the United States.*

Read June 23d, 1809.

NOTWITHSTANDING the numerous experiments that have been made by several eminent chemists, on a metallic substance, discovered by Doctor Wollaston, in combination with crude platinum, and by him called palladium; there still re-

mains much doubt with respect to the existence of such a simple substance. Professor Murray, one of the latest writers on chemistry, in speaking of palladium, and other metals found in combination with crude platinum, says; "It is not impossible that they may be alloys of others; or that the peculiar properties which they appear to exhibit, may arise from combinations which analysis has not detected. The peculiarity of their association in one natural production, while there are no traces of them in any other, perhaps lends force to this supposition." It has been my fortune, however, to obtain it from a different source; which enables me to point out some of its characters, that will throw such light on the subject, as to remove all doubts respecting the existence of this simple metal.

On the 15th of May, 1807, a deposit of gold bullion, from Brazil, in South America, was made at the Mint of the United States, weighing 797 ounces, 4 dwts., gross, equal to 819 oz. 11 dwts. 11 grs. standard. It was composed of about 120 small ingots, differing in weight; each of them was stamped on one side with the arms of Portugal, and the inscription of "Rio das Mortes." The other side was stamped with a globe. They were also marked with their respective qualities. Among them were two or three ingots, so remarkably different in colour from any of the common native alloys of gold, that I was induced to reserve one, weighing 3 ounces, 11 dwts. 12 grains, for examination, and which was subjected to the following experiments.

Experiment 1st. A portion of the reserved bar was examined for silver, by solution in the nitro-muriatic acid; but no trace of that metal was indicated.

Exp. 2d. 24 carats of this bar were combined with 48 carats of fine silver, and cupeled with pure lead, for the purpose of destroying any of the base metals that might be in combination; but there was no loss of weight produced: consequently, there were none of the easily-oxidable metals in the compound.

Exp. 3d. The pure metals from experiment 2d were reduced to a thin lamina by rollers, and subjected to the action of pure nitric acid: the silver, together with the native alloy of the gold, were dissolved by the acid, which was tinged of a

high brownish-red colour. The metals remaining undissolved, after being well washed with pure water, and ignited, weighed 22 carats  $1\frac{1}{2}$  grain; and had every appearance of pure gold.

Exp. 4th. The metals remaining undissolved in the last experiment, were submitted to the action of nitro-muriatic acid. The whole was dissolved, except a small portion of silver that had escaped the action of the nitric acid: the solution was tested for platinum, by muriate of ammoniac and other reagents, without any indications of the presence of that metal. The gold was precipitated, and found to have been pure to  $\frac{1}{3\frac{1}{4}}$  part.

Exp. 5th. To the metallic solution from experiment 3d, I added some pure muriatic acid, until the silver was precipitated, and the acid was in considerable excess: there was no precipitation of the colouring matter of the solution, which still retained its red colour, and did not appear to have undergone any change by the precipitation of the silver.

By these preliminary experiments I discovered, that the alloy was a compound of gold, and a metal that would resist the cupel, and was soluble in the nitric and nitro-muriatic acids. I therefore adopted the following mode of analysis, as the easiest, and at the same time a satisfactory evidence of the existence of a metal possessing the properties of palladium; by which name I shall call it in future.

Process 1st. The whole ingot was combined with double its weight of fine silver, and cupeled with a quantity of lead, equal to the weight of the compound.

Pro. 2d. The cupeled metals were reduced to thin plates, and submitted to the action of boiling nitric acid, until the silver and palladium were dissolved. The solution, which was of a high brownish-red colour, was decanted, and the residual gold washed with pure water, which was added to the decanted solution.

Pro. 3d. Pure muriatic acid was added to the metallic solution of process 2d, until no further precipitation took place, and the acid was in excess. The silver being completely precipitated, the fluid, which retained its red colour, was decanted; and the precipitate washed with pure water; the washings were

added to the decanted fluid, now holding nothing but palladium in solution.

Pro. 4th. A saturated solution of pure pot-ash (carbonate of pot-ash did not succeed so well, part of the palladium being held in solution by the carbonic acid) was added to the metallic solution from process 3d, until the whole of the palladium was thrown down in form of a flocculent orange-coloured precipitate. The precipitate was collected on a *filtre*;—was well washed with pure water, and dried.

Pro. 5th. A portion of the precipitate from the last process was put into a crucible, without addition, and subjected to a heat of about  $60^{\circ}$  of Wedgwood; and thus, a metallic button of palladium was obtained.

Pro. 6th. Another portion of the precipitate from process 4th was combined with black flux, and submitted to a degree of heat equal to that excited in process 5th, and similar results were obtained.

Having thus obtained a metal, which I supposed to be palladium, from a source heretofore unknown; in order still farther to satisfy myself, I separated that metal from crude platinum, and subjected them both to a number of comparative experiments, with prussiate of mercury, recent muriate of tin, and other re-agents, without discovering the least shade of difference.

Palladium is of a greyish-white colour; so closely resembling that of platinum, that they cannot be distinguished by their complexion. It is malleable, and very ductile; so that by the rolling-mill it can be reduced into thin plates. In hardness it is nearly equal to wrought iron. Its specific gravity, at  $64^{\circ}$  Fahrenheit, is  $11\frac{4}{5}$ . It may be alloyed with a number of the metals. With gold, silver, and platinum, it forms ductile alloys, and very much debases the colour of the two former.

It would be useless here to go into a further detail of the characters and properties of palladium, as Dr. Wollaston and Mr. Chenevix have fully explained them, in the Philosophical Transactions of the Royal Society of London, for 1803-4 and 5. It is enough for me to have shown, I trust satisfactorily, that palladium has a real existence; that it is one of the pure or

inoxidable metals; and, in this respect, on a par with gold, silver, and platinum; and that it has been found in a native combination with gold; without the presence of platinum, or any other metal.

Gold has never been found pure in nature; it has hitherto always been found alloyed with silver or copper; mostly a combination of both, and frequently other metals. The gold which was the subject of my experiments, appears to have been alloyed with palladium only; if any of the other known metals had been present, except silver and platinum, they would have been indicated by preliminary experiment 2d.—Silver would have been discovered by experiment 1st; and platinum by experiment 4th. It is self-evident, that this alloy was *native*; for no man would have been at the trouble and expense to purify the gold and separate the palladium from platinum, the only source from whence palladium had been heretofore obtained; and where it exists only (agreeably to Doctor Wollaston's experiments, confirmed by my own,) in the proportion of one half of one per cent., merely for the purpose of combining them with an intention of fraud; as none of the metals injures the colour of gold so much, and renders it so suspicious as palladium; and which would necessarily lead to a detection of the imposition. If fraud therefore had been intended, platinum would have answered the purpose much better; as it is not separated from gold by the usual process of assaying.

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## No. LXII.

*Observations on the Geology of the United States, explanatory of a Geological Map. By William Maclure.*

Read January 20th, 1809.

NECESSITY dictates the adoption of some system, so far as respects the classification and arrangement of names the Wernerian appears to be the most suitable, First, Because it is the most perfect and extensive in its general outlines, and